DOUBLE MUSCLING in Beef Cattle

Dr Helena Theron
SA Stud Book & Animal Improvement Ass.,
Pretoria Office
helena@studbook.co.za

One of the selection goals in specialized beef cattle breeds is to improve carcass quality. Consumers prefer meat with less fat because it is healthier with regard to coronary heart diseases. Producers and butchers require a higher meat yield and a smaller fifth quarter, which result in more edible meat cuts.

Double-muscled (DM) animals provide this type of meat. Myostatin is a protein that stops muscle growth in young animals. Mutations of the myostatin gene (MSTN) causes myostatin to be partially or completely inactive, which then causes muscles to keep on growing, resulting in certain identifiable characteristics known as the double muscling syndrome. It is present in many mammalian species, from mice to dogs and horses and even in humans.

FIGURE 1: *Belgian Blue with extreme double muscling. Photo: Pinterest.com*

WHAT CAUSES DOUBLE MUSCLING?

Around 20 mutations of the cattle Myostatin gene have already been identified. Most of these mutations don't have any visible effect, as parts of the gene are inactive. However, some mutations have a large effect and are therefore economically important. Nine mutations are currently active in beef cattle populations of which three are very common, and are included in routine DNA testing. The most common mutations are nt821, Q204X and F94L. Some of these mutations are very breed specific, while others are common across species. Some breeds have only one mutation, but more than one mutation is present in many breeds.

Characteristics of the Double Muscling (DM) Syndrome

- Extreme muscle definition.
- Large round "bubble butt" well above the hock; extreme sloping pelvis and high tail set. They often have a dirty rump (which is probably why Belgian Blues are shaved).
- Fine, thin bones; straight legs in profile; reversed or slipped knee-joint; stiff restricted rear movement.
- 'Pencil gut' (small internal organs)
- Under developed scrotum.

Advantages of double muscling

- Mainly the production of lean red meat.
- High dressing percentages due to more meat, less bone and fat and smaller internal organs.
- In Europe there is a market for DM meat.

Disadvantages

- Double-muscled animals are generally dysfunctional in most environments.
- Extreme calving difficulty, resulting in the possible loss of calves and especially heifers.
- Many health issues require specialized care.
- Lack of performance on feed make them unsuitable for finishing in feedlots.
- Males and females have many fertility issues as well as calving difficulties and a low survival rate.
- Meat needs special treatment and may also be too lean for the local market.

INHERITANCE OF DOUBLE MUSCLING

These mutations are mostly recessive, meaning an animal needs 2 copies of the defective gene to show the syndrome. It seems that the expression of the mutation genes differ between breeds, due to the influence of other genes already present, probably there due to breeder selection. For example, Belgian Blues share the same myostatin mutation (nt821) with many other breeds, but only Belgian Blues show extreme double muscling due to breeders actively selecting for it.

Sometimes the carrier animal (carries one normal gene and one mutation gene) shows absolutely no sign of the gene, and sometimes some effects are present in the carrier animal, to different degrees. nt821 and Q204X are detrimental genes as symptoms tend to be more severe. F94L is not so severe and is known as the 'profit gene', as animals carrying two alleles of this mutation have higher meat quality and less negative effects like dystocia, lowered fertility and longevity. F94L is common in the Limousin breed.

Origin (Figure 2)
Double muscling was first reported in Shorthorn cattle in the early 1800's. Some breeds in Europe are actively selecting for double muscling in their cattle, as Europe has a suckler industry and there is therefore a market in Europe for meat of double muscled animals. As cattle in Europe are farmed intensively, dystocia of double muscled cows can be prevented by scheduled caesarean sections. With smaller herds, the required special husbandry and feeding practices are also possible. This is generally not feasible in larger extensively farmed beef cattle herds in South Africa, as in the US, Canada and Australia, and as a result double muscled animals are unwanted in these countries. However, selection for an increased meatiness in beef cattle has probably resulted in an increase of carrier double-muscled (DM) animals in these countries.

What if some double muscled (DM) calves have been born in my herd? (Figure 3)
Both the sire and the dam of the affected calf are carriers of one of the DM genes. Half of a carrier bull's calves will be carriers as well therefore approximately half of his daughters kept as replacement cows will also be carriers. If you now use another carrier bull on one of your carrier cows, you have a 25% chance of having an affected calf. Using a carrier bull on a carrier cow also has a 50% chance of breeding some more carriers.

Do I have to test my whole herd?
Not necessarily. As a start, you need to use only clean bulls, i.e. bulls that have been proven by a DNA test to not carry any DM genes. In fact, the Myostatin status of all breeding bulls should be known: he has either a valid DNA test or both parents have tested clean. Using a clean bull on a carrier cow will not result in a DM calf, but has a 50% chance of a carrier calf.

Conclusion (Figure 4)
Double muscled animals may have a high meat production, but has a myriad of other problems making them highly unsuitable for South African conditions. Despite this, double-muscled calves are being born in many beef cattle breeds and herds across the world and in South Africa as well, which may indicate that the carrier animal has some advantage. However, breeding animals can be tested for their status and the birth of double muscled animals can be prevented by using clean bulls.

FIGURE 2: *Belgian Blue cow with caesarean section scar. (Photo: Wikipedia)*

FIGURE 3: *South African bull showing double-muscling (Photo: Dolf Cloete; SA Stud Book)*

FIGURE 4: *Hidden genes: Despite these carrier cows looking normal, they are carriers of DM genes. When mated to a carrier bull, there was only a 25% chance of producing these DM calves. These breeders have inadvertently used carrier bulls on at least two occasions: when breeding the dams and when breeding the calves.*